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Making the Kessel Run: Re-Insourcing Software Development in the U.S. Air Force

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Making the Kessel Run: Re-Insourcing Software Development in the U.S. Air Force

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Kathryn Aten—is an expert in organization science focusing on the adoption and use of emerging and information technologies. She draws on her expertise using surveys, behavior observation, focus groups, and individual interviews to help Navy leaders reduce technology acquisition and transition costs, design innovative systems for manning, and develop resilient warfighters and systems. Her research and publications investigate how individuals and organizations adopt and transition technologies as well as how technology implementations influence work and communication. Aten teaches strategic management and change, strategic management of information technology, research design, and qualitative and applied research methods.

Abstract

The U.S. Air Force has traditionally acquired software through the military acquisition process. This acquisition process is used broadly for diverse types of purchases and requires considerable time. Concerned that this approach is not ideally suited for the acquisition of rapidly evolving, innovative software, the U.S. Air Force re-assessed its previous make or buy decision regarding software and stood up Kessel Run. Kessel Run is an innovative, in-house software development organization, intended to assess the viability of "re-insourcing" software development. This research reports on a case analysis of Kessel Run. We explore why and how the Air Force developed Kessel Run and offer insights into its operation. Our results suggest that, while cost-reduction goals certainly facilitated Kessel Run's origin and cost reduction has remained a benefit, the primary driver and benefit of re-insourcing Kessel Run is capability development. This finding seems to support a resource-based logic to insourcing. Our results also show that the leaders of Kessel Run succeeded in establishing the organization by relying on commercial start-up concepts, which allowed the organization to attract talent, develop capabilities, and meet customer needs far faster than typical acquisition approaches. We identify lessons learned and implications for other re-insourcing opportunities.

Background

Software is a critical component of defense weapon systems, but "some of the costliest failures in military procurement have been blamed on software ... [and] ... billions of dollars continue to be spent on software projects that are way over budget and behind schedule" (Erwin, 2018). Software development, when successful, may take years in the traditional procurement process, from requirement inception to software deployment in the operational Air Force (see, e.g., Wallace, 2018). Software development delayed the F/A-22 aircraft (National Research Council, 2007) and the U.S. Air Force (USAF) canceled the Expeditionary Combat Support System with more than \$1 billion of sunk obligated funding, when it determined another billion dollars would not salvage the program (Kanaracus, 2012). While the rest of the Air Force and the DoD are still outsourcing most of their innovative acquisitions, including software



development—contractors are responsible for the bulk of U.S. defense software development (Jones, 2002)—the Air Force’s Kessel Run, an internal software development organization, has decreased the time to field software substantially from years to weeks.

Because the DoD’s operation and support costs have not commensurately declined with the ongoing personnel reduction since the Cold War, the DoD resorted to outsourcing or buying functions that are not considered core competencies (Office of Management and Budget [OMB], 1983). Software development is one such outsourced function, traditionally occurring through legally binding instruments governed by the Federal Acquisition Regulation (FAR), Air Force Installation Contracting Center (AFICC) guidance, and other regulatory bodies (Air Force Installation Contracting Center, n.d.; Federal Acquisition Regulation [FAR], n.d.). Three common methods of procuring custom software exist: the procurement of custom software as a commodity using typical contracting approaches, the procurement of software as a service (SaaS) using typical contracting approaches, and the procurement of custom software utilizing Other Transaction Authorities (OTAs; OTA Brief, 2016). While all three methods rely heavily on industry efforts, the former two options are subject to the FAR as opposed to OTAs (OTA Brief, 2016).

With the addition of Kessel Run, a modern approach has altered the software development process and enables the Air Force to self-develop software. Kessel Run has significantly reduced software development lead time by applying agile software development. Agile development is an “extreme” form of programming, used for “complex, volatile” requirements that include “erratic” changes (Highsmith, 2002). By re-insourcing software development and applying agile software approaches, the Air Force has reduced software development cycle times in some cases from years to weeks; however, this is not an easy transition because insourcing requires the Air Force to revamp training for active-duty members and defense civilians in coding and cyber defense core competencies that are unfamiliar to the current workforce (Williams, 2018).

The Air Force has traditionally relied on outsourcing software development but has taken a new direction with Kessel Run. This case study explores Kessel Run, and seeks to understand its insourcing approach and how that approach benefits its customers, when compared with the traditional outsourcing acquisition approach.

Background and Literature Review

Make or Buy Decisions

The decision to make or buy supplies or services within an organization can be complex, but it is one of the most important decisions to make; it is fundamentally a decision on how an organization will manage its supply chain, and thus, it impacts many other decisions and processes (Henriksen et al., 2012). Organizations engaging in strategic make or buy decisions must identify their core competencies (Prahalad & Hamel, 1990). By examining any competitive advantages that arise from those competencies, organizations can litmus test their continued relevance to the organization (Leonard-Barton, 1992). If competencies remain relevant to competitive advantage, the organization should retain these competencies in-house (“make” them). If irrelevant to competitive advantage, the organization should consider the competency with the bulk of other tasks that may potentially be outsourced (“buy”). Then, the organization must conduct transaction cost analysis to better discern what tasks should be kept in-house and what may be outsourced (Williamson, 1996). To this basic framework, Quinn and Hilmer (1994) add that organizations must also consider their vulnerabilities if markets fail in providing outsourced products and services, and how best to mitigate those vulnerabilities.



Core Competencies and Competitive Advantage

At its essence, a core competence embodies the strength of an organization and is typically something the organization has dedicated itself to perfecting. It is “a harmonized combination of multiple resources and skills that distinguish a firm ¹[or an organization] in the marketplace” (2013, p. 117). In industry, a core competence must meet three criteria (military analogs are straightforward):

- It must provide access to a wide variety of markets
- It must make a significant contribution to the perceived consumer benefits
- And it must be difficult for competitors to imitate (Prahalad & Hamel, 1990).

An organization’s competence must meet all three criteria, and the organization must continuously develop and invest in the competence, to maintain its benefits.

Being integral aspects to their strategies, firms do not intentionally outsource core competencies (Hudgens, 2008). Although in some cases circumstances may change and a core competency is either unnecessary or harmful, core competencies must be performed organically. Leonard-Barton (1992) defines harmful core competencies as “core rigidities” (p. 188) and explores how previously beneficial competencies can hinder the development of new or innovative capabilities. An organization would be well served to abandon, or limit the influence of, any competencies that have become problematic as they create problems (Leonard-Barton, 1992). When an organization is able to grow and maintain core competencies, competitive advantages arise that give it an edge over its competition (Prahalad & Hamel, 1990).

Transaction Costs

Transactions costs are the costs incurred by an organization in the process of conducting business (Chen, 2019). More specifically, transaction costs refer to costs associated with searching, communicating, and bargaining activities (Klein, 2013). Firms and organizations, including the Air Force, need to consider transaction costs when making decisions on how they conduct business.

The Nobel economist Ronald Coase first conceptualized the idea of transaction costs in his article “The Nature of the Firm” published in 1937 (Klein, 2013). While Coase’s purpose for his article was to define the term *firm* that, at the time, was widely used but apparently ill-defined, he succeeded in doing more. As Coase explained, “the main reasons why it is profitable to establish a firm would seem to be that there is a cost of using the price mechanism” (1937, p. 390). The price mechanism to which Coase refers is the “invisible hand” specter that guides market transactions so that resources may flow to where they may be most efficiently utilized. Coase gives his abstract cost reference body by providing examples. The first such example is the cost of determining germane market pricing that, while able to be minimized through specialization (e.g., third-party pricing databases), cannot be avoided (Coase, 1937). Negotiating contracts for each transaction also represents a cost that firms can streamline although not eliminate completely (Coase, 1937). Coase does not explore every possible

¹ Some core ideas come from literature on business, management, and industry, and thus refer to firms; the ideas typically apply directly to other organizations, particularly the military contexts in this paper. This is especially true given the discussion focuses on whether to insource or outsource a function, which would involve the military (here, the Air Force) interacting with industry as part of its proposed supply chain for any outsourced goods or services.



transaction cost, but he explains that executing transactions come at a cost, and firms may reduce these transactions (Coase, 1937).

Oliver Williamson (1981) expanded on Coase's exploration of transaction costs in "The Economics of Organization: The Transaction Cost Approach," where he described these costs as the economic counterpart to friction. While one may look to moving mechanical parts of a machine and the friction experienced where parts meet to judge its efficiency, Williamson (1981) explains that economic friction may arise in how cooperatively, or uncooperatively, parties interact. Williamson (1981) opined that "transaction cost analysis is an interdisciplinary approach to the study of organizations that joins economics, organization theory, and ... contract law." Transactional costs are more than just a reason for the existence of firms; they drive the way firms make decisions.

Williamson (1996) stated, "Whether a firm makes or buys—that is, produces for its own needs or procures a good or service from an outside supplier—turns largely on the transaction costs of managing the transaction in the firm, as compared with mediating the transaction through the market" (p. 25). As discussed, these transaction costs represent the costs required to conduct business with outside vendors or to maintain the support infrastructure to fulfill the requirement organically. If filled organically, transaction costs can include training personnel, maintaining equipment, or similar costs (Coase, 1937). If outsourced, costs may be incurred for monitoring vendor performance or conducting lengthy negotiations (Coase, 1937). An organization must include this assessment of transaction costs in any make or buy decision.

Government Policy on the Make or Buy Decision

Government and DoD outsourcing policy is rooted in United States Code. Further regulations and policies are implemented through national defense authorization acts passed by Congress and through Office of Management and Budget Circular A-76 (OMB, 1983; RAND, 1997). OMB Circular A-76 addresses the make or buy decision, authorizing insourcing in four distinct circumstances: there are no satisfactory commercial sources available, matters related to national defense, patient care, and lower cost (OMB Circular, 1999). The OMB (1999) clarifies that "the general policy of the Government [is] to rely on commercial sources to supply the products and services the Government needs" (p. 1). The OMB also states that "it is the policy of the United States Government to: achieve economy and enhance productivity, retain Governmental functions in-house, and rely on the commercial sector" (OMB Circular, 1999, pp. 1–2).

The DoD relies on the national defense insourcing language to exclude 58% of 640,000 positions conducting commercial activities from outsourcing (RAND, 1997). The same report cites several studies that identify savings, both from insourcing and outsourcing activities, ranging from 20%–35%, although inconsistencies related to actual versus projected savings may exist (RAND, 1997). DoD-specific policy is driven by two DoD Directives: *4100.15 Commercial Activities Program* (DoD, 1985a) and DoD Instruction *4100.33 Commercial Activities Program Procedures* (DoD, 1985b; RAND, 1997). Directive 4100.15 (DoD, 1985a) essentially parrots OMB Circular policy and assigns specific responsibilities to government positions while Directive 4100.33 (DoD, 1985b) describes the procedures for determining whether government personnel or commercial sources should satisfy needs. More recently, DoD Directive *1100.4 Guidance for Manpower Management* (DoD, 2005) detailed policy that "assigned missions shall be accomplished using the least costly mix of personnel (military, civilian, and contract) consistent with military requirements and other needs of the Department" (p. 3).

Policy indicates that commercial activities not subject to OMB's four general exceptions should be outsourced to commercial activities. However, DoD Directive 1100.4 goes further and



mandates that personnel address military needs with the least costly mix of labor. While the policy does note that the “least costly” approach must be consistent with military requirements, which presumably would include requirements driving a need to keep core functions in house, this directive seems to encourage outsourcing for cost reduction versus attempting to focus on core competencies.

Air Force Policy Directive 38-1 (Department of the Air Force, 2019) echoes DoD Directive 1100.4 by also requiring the least costly mix of personnel to meet military and Air Force needs. Supporting this “least costly” argument, the *Government-Wide Category Management Guidance Document* (Office of the Secretary of Defense, 2015) contains no reference to core competencies or competitive advantages while returning 91 instances of “cost” and 48 instances of “saving.” Through the policy documents, directives, and the current focus on category management in government acquisition, it would appear that government make or buy decisions are primarily driven by cost reduction objectives instead of core competency objectives.

Research Approach

This study seeks to understand why and how the Air Force stood up the Kessel Run organization to internally develop (insource/make) software in lieu of the traditional method of procurement by contracting (outsource/buy). This case study focuses on an explanatory analysis (Yin, 2018) of Kessel Run to provide background and rationale for its beginning. An explanatory case study is a study whose purpose is to explain how or why some condition came to be (e.g., how or why some sequence of events occurred or did not occur; Yin, 2018). Studies asking “why” and “how” questions typically seek more explanatory results, which supports the use of the case study, history, or experiment as the preferred method of research (Yin, 2018).

The case study is designed around qualitative analysis of Kessel Run as an organization. The qualitative analysis extracts data in three forms: 1) information provided directly by the Kessel Run staff and leadership, including information posted on U.S. Air Force official websites, 2) information collected from interviews from Kessel Run members, and 3) information posted publicly by those outside of the organization. Because Kessel Run is a new organization, our four interview included participants whose experience in the organization ranged from 7 months to 2 and a half years.

Kessel Run: The Organization

The Air Force wanted their new organization to be fast and agile. They chose the name, Kessel Run, from the movie *Star Wars* and specifically the scene where Han Solo is showing his starship, the *Millenium Falcon*, to Obi-Wan Kanobi. Han tells Obi-Wan that his starship is so fast that it did “the Kessel Run in less than 12 parsecs” (Kelman, 2019).

Although Kessel Run stood up as an independent organization in May 2018, its inception started back in August 2017 and was initiated by the Targeting & Geospatial Intelligence (GEOINT) (T&G) Modernization Program and the [recently terminated] Air Operations Center (AOC) 10.2 program (Kessel Run, n.d.). According to the Kessel Run Acquisition and Contracting Playbook (2019), Kessel Run was originally developed to fill a specific goal which was to:

Deliver Air Operations Center (AOC) 10.2 Dynamic Targeting Mission Thread, including modern platform and automating associated 3rd party systems, alongside AOC 10.1 at 609th (AFCENT) in <12 months; initial delivery within 90 days of letting contracts...nominally six (6) applications in initial phase. (Kessel Run, n.d.)



Kessel Run quickly expanded to T&G's and AOC's entire portfolio, which was a direct reflection of the value they provide. Now, they are a detachment within the Air Force Life Cycle Management Center (AFLCMC/HBH; 2019).

According to the Kessel Run Acquisition and Contract Playbook (2019), the mission of Kessel Run is to “continuously deliver war-winning software our Airmen love.” Additionally, the vision of Kessel Run is to “Build a software company that can sense and respond to conflict in any domain, anytime, anywhere” (2019). Upon reading the mission and vision, it is apparent the mission reads similar to civilian software development agencies, like Google, which highlight the importance of employee satisfaction and its correlation to productivity and creativity (Forbes Technology Council, 2018). The vision is closer to the typical military vision, which incorporates the wartime (“conflict”) mission and rapid (“anytime”) deployment.

Kessel Run practices “Lean Product Development,” “Extreme Programming,” and “User Centered Design” (Kessel Run, n.d.). Being lean allows them to, “validate our assumptions and mitigate risk at every turn”; extreme programming allows them to, “always feel confident to go fast, forever”; and their user-centered approach ensures that they “are always delivering value to our users” (Kessel Run, n.d.). The development process follows an 11-step process that includes predictable steps such as “Value Stream Mapping,” “Product Scoping,” and “Testable,” but also such non-military steps as the “Vader Sprint” (a risk-mitigation step) and the final step, “Joyful,” which focuses ensuring users adopt the product joyfully and plans for the sunset of the software in its eventual legacy state (Sanders, n.d.).

Is Kessel Run's process working? It reports software development results that include: 1) average time from concept to operations of approximately 4.5 months, 2) reduction of lead time from 5 years to 3.5 days, 3) the ability to push continuous authority to operate to the secure network in less than one hour, and 4) an observed production deployment frequency (capabilities to operations) of 42 capabilities per month, among other improvements and accomplishments (Sanders, n.d.). During our study, we analyzed one project that was completed—from concept inception to operation—in 88 days, or just under 3 months.

Analysis

We wanted to understand why and how the Air Force stood up Kessel Run, so we explored its origin, its purpose, and possible make or buy decision motives, as well as factors that explained Kessel Run's organization and culture.

Kessel Run Origin: A New Hope

Kessel Run rose from a previous failure. When asked, “Why was Kessel Run created?” three of four respondents mentioned AOC 10.2. One respondent reported, “Kessel Run was built out of the ashes of a \$500 million effort to modernize the AOC Weapon System, originally called AOC 10.2. After spending 10 years and \$500 million and delivering absolutely nothing, Congress cancelled the program” (Participant A). Another interview response was “The failed 10.2 program [AOC 10.2] opened the door to prove out a different way of software development and delivery” (Participant C). Third, “AOC 10.2 failed to deliver any working software in 10 years.... Rather than continue the old way of doing things, we decided to take the bull by the horns and build software in partnership with industry. That way, the government owns the code and can modify the code as necessary without contracting actions” (Participant D). AOC 10.2 was a project the Air Force contracted for with Northrop Grumman to upgrade the Air Operations Center network (Insinna, 2017). After not receiving a finished product in ten years and spending over \$500 million, Congress decided to quit funding the program and the Air Force cancelled the project to seek an alternative solution (Innis, 2017). Flowing from this



failure, the USAF launched AOC Pathfinder which would include “industry best practices” and “incorporate an agile software development technique called DevOps” (Insinna, 2017). Per the interview responses, one respondent explained that Kessel Run was formally known as AOC Pathfinder. Furthermore, one respondent clarified, “the AOC Pathfinder, now known as Kessel Run” (Participant A).

Why Make the Kessel Run? Software Development Spending

Given, Kessel Run arose from a failed \$500 million investment, we expected costs would be a strong motivation to re-insource software development. We first performed a spend analysis which revealed that costs of traditionally procured software development have increased tremendously in recent years. We used the Computer Program and Software Development North American Industry Classification System (NAICS) code 541511 because we concluded that it was most aligned with Kessel Run’s mission. Furthermore, we used NAICS code 541511 because the alternative Product and Service Code (PSC) classification system was more confusing and did not provide a clear PSC for software development. The spend analysis was conducted with Federal Procurement Data System (FPDS) and Air Force Business Intelligence (AFBIT) Competency Cell data (“Air Force Business Intelligence Lite - Profile | Tableau Public,” n.d.; “Federal Procurement Data System—Next Generation,” n.d.). While FPDS contains data for all sectors of Government contracting, the data pulled from FPDS only included the Contracting Office Agency identification code 5700, which represents Air Force contracting offices. Both FPDS and AFBIT data were separately sorted in chronological order and adjusted for inflation. We converted the raw FPDS and AFBIT data into 2017 and 2018 dollars, respectively, by factoring in the appropriate Consumer Price Index (CPI) figure from the Bureau of Labor Statistics (U.S. Bureau of Labor Statistics, n.d.). Furthermore, we plotted each data on a graph where the Y-axis shows the obligation or spend amount and the X-axis represents years pertinent to the data. A trendline and equation were generated to define the slope that provides the average change in obligation or spend amount and the best-fit R-squared value for each sample. Figure 1 represents FPDS data measured by obligated dollars from FY2011 to FY2017 and concluded with an average increase of approximately \$90 million per year with an R-squared value of 0.7745.

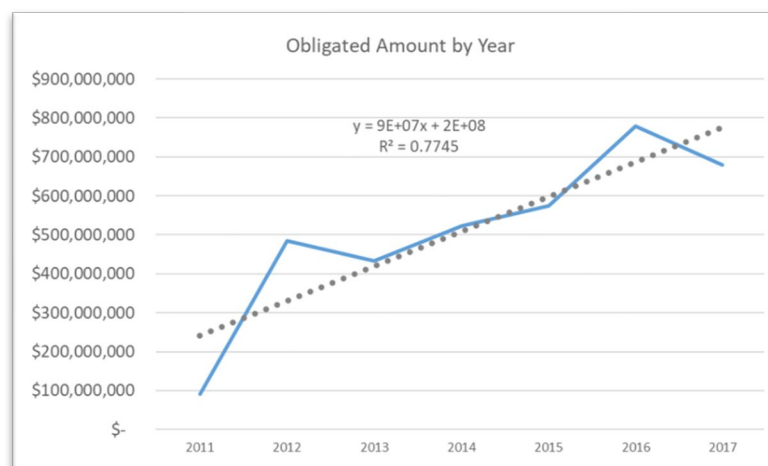


Figure 1: FPDS Data (USAF Data from Federal Database) Spend Analysis of NAICS 541511 from FY11–17 with a Trendline

Figure 2 represents AFBIT data measured by spend amount from FY2014 to FY2018 and concluded with an average increase of approximately \$100 million per year with an R-squared value of 0.9392.



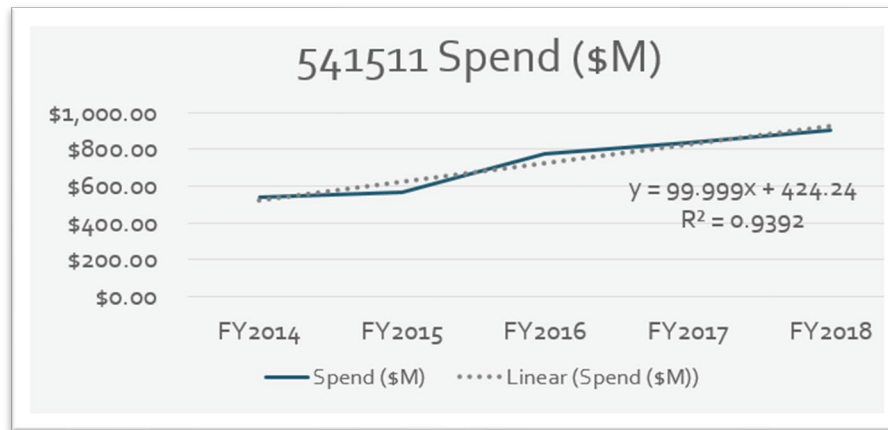


Figure 2: AFBIT Data (USAF Data from USAF Database) Spend Analysis of NAICS 541511 from FY14–18 with a trendline

The second spend analysis with AFBIT data verifies the Air Force’s aggressive increase in average dollars per year spent on software development under NAICS code 541511. While both sets of data have relatively high best-fit R-squared values, which indicates that the trendlines are more representative of the data than not, we noted that the available data for the overlapping years between the two samples are inconsistent. This discrepancy calls the sources of the data into question and provides the appearance of data manipulation before we extracted the data. That said, these are the official data sets that document government spending for the federal government and the Air Force respectively, and thus represent the best sources of data available. Additionally, both sets of data presented an indisputable, substantial increase in Air Force computer programming and software development spending over the years at an average \$90 million to \$100 million per year. The spend analysis yields compelling results that could explain the adoption of more agile software development methods, such as the creation of Kessel Run.

Why Make the Kessel Run? Organizational Purpose

Federal policy states that commercially available requirements should be contracted out and cost comparisons should be conducted to the maximum extent practicable to determine the best organization for fulfilling a requirement (OMB, 1983). As our spend analysis shows, software development costs are increasing generally, and combining that general trend with the specific sting of the failed \$500 million AOC 10.2 effort might justify a pilot test to re-insource the capability. However, our study suggested a competing motive.

According to Kessel Run’s official website, the organization’s purpose and mission is “Continuously delivering war-winning software our airmen love” (Kessel Run, n.d.). Additionally, none of our interview participants mentioned costs as a primary motivation. When asked “What is the purpose of Kessel Run?” interview respondents offered similar responses for the organization’s purpose: changing the way the Air Force delivers software by continuous delivery and delivering software the warfighters love. According to one interview response, “Kessel Run is modernizing the Air Operations Center Weapon System through user-centered design, lean start up management and other industry best practices. Our mission is to build and deliver software that warfighters LOVE [emphasis in original response]” (Participant A). Another interview response claimed to purpose was “to change the way the Air Force and DoD delivers software” (Participant B). Furthermore, the third interview response agreed the organizational purpose was “to continuously deliver war winning software that the warfighter loves” (Participant

C). Finally, the last interview respondent reported, “To build the capacity to sense and respond to a changing threat environment with software. While we build products that warfighters love, we could throw those products out the window and still have the ability to deliver combat capability. That is the true power of Kessel Run” (Participant D).

Making the Kessel Run: Building Organic Capability

Interestingly, developing an organic capability might have been more coincidental than intentional (Kelman, 2019). Program Executive Officer, Digital, Steve Wert was more concerned with improving agility no matter the mix of government and contractor blend (Kelman, 2019). He elaborated, “We were primarily looking to demonstrate that modern commercial practice could be successfully applied at scale with the DoD” (Kelman, 2019). That re-insourcing became the preferred approach appears to be a happy consequence. Owning the work and intellectual property and knowing software development practices is instrumental in Kessel Run’s effectiveness. As one of our respondents reports, “Having in-house expertise ensures that the Government owns the code baseline and the product development.... The other element is that when we do contract with companies to provide service-based support, we have the in-house technical ability to assess whether a company is performing appropriately” (Participant A).

External observers seem to agree. Kelman (2019), for example claimed Kessel Run leverages “both the use of agile and an increasing role for organic capacity in software development—two issues that are not so related but are being pursued together under the moniker ‘Kessel Run’” (Kelman, 2019). Industry adopted these processes about a decade ago (Pomerleau, 2019), and our data suggests the DoD is well aware its software development practices are outdated and unable to effectively enable the mission. The Defense Acquisition University Powerful Example Library (2019) notes, “Its [Kessel Run’s] non-standard approach is designed to do two things, speed up the acquisition process and turn the Air Force into a software company that happens to fly planes.”

The agility and organic capability appear to be important to Kessel Run and represent a completely different approach to how the DoD normally develops software. Cost does not seem to be a major point of concern when it comes to agility; however, interview respondents were frankly concerned that the slow delivery of software through traditional approaches which hinders the warfighter from obtaining relevant software. An interview respondent explained, “The information we’re planning off of has changed and may no longer be valid or important” (Participant B). Another respondent answered, “Traditional acquisitions lends itself to a waterfall approach, i.e., requirements, contract award, development, test, security, compliance, and then fielding. This sequence of events takes more than 10 years on average. This means that the warfighter goes 10+ years without the software they need” (Participant D). The fact that the warfighter is not supported appropriately because of acquisition bureaucracies and inefficiencies is extremely alarming and the USAF has recognized this deficiency.

Making the Kessel Run: It Takes a Different Approach

The Air Force seemed to realize that achieving Kessel Run’s goals of speed and agility would require cultural changes, essentially “building a software lab in Boston that was modeled after successful Silicon Valley companies” (“Air Force teaming with Pivotal to rapidly deploy software worldwide,” 2019). According to one participant, “Kessel Run utilizes industry and Silicon Valley best practices like lean start up management, user-centered design, and DevSecOps” (Participant A). One respondent emphasized that *The Lean Startup* “was essentially our Bible [sic]” (Participant D). Participants referred to, far more than to government instructions, a list of references that would be comfortable on the shelf (or in the digital library) of any Silicon Valley startup: *Start Up Way*, *Development and Software Operations (DevOps)* *Research and Assessment (DORA)*—*State of DevOps*, *Accelerate: Building and Scaling High*



Performing Technology Organizations, Sense and Respond, How Google Works, Lean Enterprise, The Lean Startup, Extreme Programming, and Design Thinking. One participant summarized the startup mentality: “We were very scrappy” (Participant D).

A different culture meant adopting different management practices. One of the interview participants noted:

things like psychological safety are valued so the most optimal decisions can be made. The traditional military hierarchy that enabled Platoon leaders to navigate the jungles of Vietnam don’t [sic] work for a modern software organization. The highest ranked person doesn’t always have the context or knowledge to make or inform the decision; our flat management structure at the product team level allows decisions to be made by the right people. (Participant 4)

Psychological safety appears to be very important to the organization and its success. We asked for a list of potential interview participants, including an explanation for why they could provide key insights; a key informant responded, “At Kessel Run, we don’t concern ourselves with rank. We put the best people in the roles, whether they are an E-5 or a 2Lt (Second Lieutenant)” (participant, email to author, October 1, 2019). One outside observer collaborated this observation, “it is not every 36-year Air Force old-timer who is willing to listen to kids in hoodies, and even to allow them to name a pet project after a favorite Star Wars trope. (Kudos to the Air Force as well for not squelching this name.)” (Kelman, 2019). This enables Kessel Run’s innovation and ability to obtain useful information from any source without dealing with the same bureaucracy witnessed in the rest of the USAF and DoD.

To build this new start up, Kessel Run was challenged to interface with and develop methods to attract the “New Workforce,” which: 1) was born between 1980 and 2000, 2) prefers cities or large towns, and 3) would trade other benefits for better workspace (Newell, 2018). Furtado explains, “We’re battling industry, especially in Boston, for top end tech talent. ... You can’t ask people to hey come and take a \$30,000 pay cut, also it’s going to be a bad environment and you’re not going to be happy here” (Pomerleau, 2019). Consequently, Kessel Run operates out of a “brightly lit We Work office” in Boston (Ward, 2019). Alongside startup companies, “T-shirt-and-jeans-wearing airmen milling around its fully-stocked kitchenette” might be indistinguishable, other than “[sounding] a bit different from their similarly dressed office mates” (Newell, 2018).

Admittedly concerned about competing with industry for hiring and retaining talent, the Air Force first invested in developing its own coding talent, recruiting Airmen from around the Air Force and putting them through 6 months of agile coding training (Kelman, 2019).

Interview participants reported training Airmen in software development provided several benefits over outsourcing software development:

- Owning the software and intellectual property
- Reducing the contractor’s competing goals
- Government open-source model enables sharing between teams
- Efficient tactical strategic execution with Government code repository
- Ability to assess contractor performance (Participants A, B, and D)

Not only did the USAF adopt industry’s practices to attract top tech talent, Kessel Run also took a page out of industry’s coding practices by employing continuous delivery methods (Johnson, 2019). The waterfall approach of traditional acquisitions takes years. Continuous authority to operate (ATO) is a best practice adopted from industry which replaces the process of testing all of the code at the end of the project and makes developing software quicker



(Pomerleau, 2019). Essentially, Continuous ATO allows Kessel Run to constantly be working instead of waiting for approvals which can take time.

According to an interview response, “There are numerous companies who continuously deliver software. Even though we’re the government, why couldn’t we get to a state where we were also able to do it. Companies, such as Amazon, Google, and Pivotal, have provided numerous lessons learned that we can use to grow” (Participant D). Using continuous user feedback loops, continuous delivery means software is delivered in weeks and is reiterated to make it better throughout its use. It is not a final end-product that takes years to deploy without effective feedback mechanisms (Johnson, 2019). Colonel Oti, the Detachment Commander for Kessel Run, explained, “Continuous testing of increments of software is crucial to speeding up deployment, and prevents the do-loop of software not being tested till the end, problems discovered, and a cycle of fixes and re-tests. It is never perfect the first time around, but changes can be made based on feedback from initial use” (Kelman, 2018; Kessel Run, n.d.).

The continuous delivery method is aligned with DevOps, an approach which initially produces a “minimally viable product” (Rosenberg, 2019). According to Chaillan, the co-director of the DoD Enterprise Development, Cyber Security, and Software Operations (DevSecOps) Initiative, “When you add cybersecurity experts to this process, working alongside both the developers and the users/operators from the beginning to ensure the code isn’t easily hacked, DevOps becomes DevSecOps” (Rosenberg, 2019).

Is It Fast Enough? Is That Good Enough? The Metrics

Our interview participants all noted four Software Delivery Performance Metrics from Accelerate:

- Deployment Frequency
- Lead Time
- Mean Time to Restore
- Change Failure Rate

Kessel Run’s metrics clearly focus on time, and it is interesting that Kessel Run does not include cost as a significant metric. We had initially expected cost might be an important metric, based on our spend analysis results, but that is not the case. The organization may be performing cost efficiently, such that that cost is not a significant concern to them, or they might be leveraging improved practices to reduce costs; regardless, cost is not a top metric Kessel Run uses to run its organization.

Kessel Run does, however, include two additional core metrics. The first is called “The One Metric That Matters (OMTM).” This metric answers the question posed by the chief of staff of the Air Force, “What combat capability are you delivering?” One of the interview respondents defines it as, “the ‘north star,’ which determines whether a product is bringing user value” (Participant A). Finally, one respondent expressed interest in Kessel Run’s personnel turnover rates because “I want to make Kessel Run the place where people want to come and work” (Participant D). Given a need to develop and retain talent as part of this new competency, this metric makes sense.

Outrunning the Imperial Starships: A Few Obstacles

Perhaps unsurprisingly, the interview respondents primarily keyed in on the obstacle of gaining senior leadership’s trust. Interestingly, the challenge most interviewees disclosed was communication among all of the stakeholders.

The obstacle most mentioned in the interviews was gaining USAF acquisition leaders’ trust in taking a new approach in DoD software development. As stated by one respondent,



The hardest part was gaining senior leaders trust on a completely different approach. ... Not doing requirements-based development was a radical change for them. We had to convince leadership to allow us to talk to our users, cloud enabled IT can provide mission assurance, test and security can be incorporated into the development process, and we should use commercial IaaS [Infrastructure as a Service] and PaaS [Platform as a Service] instead of trying to build our own. Also, had to be honest with them that our culture and infrastructure suck so bad it's impending success for innovation, culture sucks because we have way too many gates before we can get to the user (lack of trust) and engineers are just watching people work and infrastructure because we can't develop software and attract top talent in our crumbling infrastructure at Hanscom AFB [Air Force Base] (both networks and facilities) [sic]. (Participant C)

Another respondent shared,

Fear of the unknown. Most of the senior leaders in AF acquisitions have been in their profession a long time. As people grow in their careers, they generally become more risk averse because there is no incentive to take risks. Taking risks is actually a disincentive. A shift from being completely requirements driven to a combination of what I call big "R" requirements (as laid out by ACC) and small "r" requirements (gathered through user-centered design) was met with much skepticism. Accepting that we don't know everything upfront was quite the mindset shift. We learn more as we iterate. We had to educate senior leadership about how not knowing everything upfront and then building things in small increments buys down the level of risk you incur. In addition to fear of the unknown, we had a culture that didn't optimize for doing the best thing for the user. Recognizing that culture had a lot of room for improvement allowed us to make the necessary changes to be more user-focused, attract top talent, and make decisions based on ideas and context, not rank. (Participant D)

As previously mentioned, Kessel Run is taking a new approach to software development, both USAF- and DoD-wide. While it may seem like the obstacle Kessel Run faced is nothing special, it is a considerable stumbling stone when trying to be agile. As another interview expressed, "it makes it difficult sometimes to get things done" (Participant A).

They Made the Kessel Run? So What?

In addition to clear wins in terms of development speed, when asked "How has Kessel Run impacted the Air Force's software development capabilities?" many of the respondents noted that Kessel Run pioneered a different way to deliver software to the Air Force and former Kessel Run members launched more software factories in the Air Force, including Section 31, BESPIN, LevelUp, and SpaceCamp (Participants C and D). One respondent answered, "The largest impact is the conversation Kessel Run has started" (Participant B). By leading the way for change in Air Force software development, Kessel Run has started the conversation of operating differently and adopting industry's best practices and enabled the potential for more radical changes in the military.

Conclusions

We set out to understand why and how the Air Force established Kessel Run, and how its insourced approach benefits its customers when compared with the traditional outsourcing acquisition approach.

One of the research questions we wanted to answer in this case study was, "Why did the Air Force decide to internally develop (insource) software using the Kessel Run organization in



lieu of the traditional method of contracting for software (outsource)?” Initially, we believed that rising software development costs drove the desire to create Kessel Run. Viewed through the lens of the make or buy decision, it appeared that the decision to insource made sense from a cost perspective. Based on spend data analysis, the cost of contracting for software development has increased dramatically over the last 5 years. As the failed AOC 10.2 project demonstrated, the cost of capabilities the Air Force sought to procure far outpaced the actual value of the end result. In an era of ever-tightening budgets and fiscal hawks seeking to cut costs, any budget item that shows increasing costs gets put in the crosshairs—sighted up for elimination. The spend data analysis supports the idea that software procurement costs are rising, and we anticipated interview responses to identify costs as a reason for establishing Kessel Run.

Despite the costly and doomed-to-fail AOC 10.2 program giving Kessel Run the opportunity to exist, and the general increasing trend in costs for software development, our analysis discovered that cost metrics were not a primary focus of the organization. Indeed, cost savings appear to be more of a welcome but unintended side effect of Kessel Run’s success. Based on our analysis of official communication, interviews with Kessel Run members, and external sources, Kessel Run was created to continuously deliver war-winning software for the warfighter at an unprecedented pace (Kessel Run Acquisition and Contracting Playbook, 2019). Delivering capable and responsive capabilities to their end user is the motivator for Kessel Run personnel. Kessel Run, it appears, was created to re-insource and develop capabilities.

The second research question was, “How did the Air Force develop the Kessel Run organization?” Traditionally, military bureaucracy is slow to act and slow to change. In this organization, steeped in hierarchical structures and procedurally based actions, new initiatives take time to develop. Federal policy appears to prioritize commercial activity contracting versus competing with the private sector as well as cost reduction versus a core competency focus. However, Kessel Run sought to return software development capacity back to the military. Seemingly somewhat out of line with federal policy, the organization prioritized competency development with no direct goal of reducing costs.

Based on analysis of Kessel Run’s published literature, personnel interviews, and information from outside of the organization, Kessel Run circumvented the traditional bureaucratic organizational structure by learning and imitating industry best practices. Founding members leaned heavily on startup literature such as *The Lean Startup* to establish the organization’s identity. Organizing and behaving like a startup company instead of a traditional military organization enables Kessel Run to attract talent, swiftly respond to customer needs, and deliver capabilities at a rate unmatched in traditional government procurement.

Recommendations

Why does Kessel Run matter? Because the end-user and the Air Force mission matter. Kessel Run has adopted a proven civilian method to develop, administer, and maintain software in a very short amount of time and at a cost much lower than the traditional method of procurement.

The most impactful aspect of Kessel Run’s success is the organization’s delivery, administration, and maintenance of effective software for the warfighter. The organization’s ability to overcoming the shortfall of the AOC 10.2 program through continuous capability development is an example of the support the warfighter deserves. Kessel Run is built around the Air Force’s mission and a dedication to the warfighter. It is apparent that they pride themselves on their ability to rapidly deliver innovative state-of-the-art software in any domain at any time.



The second take-away is that Kessel Run has shown that alternatives to the traditional procurement cycle can be effective and can work within the Air Force. Kessel Run was able to circumvent the typical military bureaucracy by adopting the practices and methods of new-age startup tech companies as well as large established tech companies, like Google. Removing or reducing red tape and embracing an agile, innovative structure can deliver positive products, reduce timelines, and save money. Kessel Run is proof that deviating from the standard operating mode of military software development is possible and can benefit both direct end users and the Air Force as a whole.

Kessel Run has proven that a nontraditional organization can benefit the Air Force. However, that does not mean that a Kessel Run-type organization is the right response to all procurement shortcomings. Based on our findings, however, the Air Force should explore areas where vulnerabilities might exist if the market fails outsourced needs (Quinn & Hilmer, 1994), and that failure would represent unacceptable risk to mission execution and determine if insourcing the capability is a viable alternative. Although a startup-structured organization may not be the best way to insource in all situations, asking the question of whether something should be insourced will force the Air Force to identify areas of outsourced risk to mitigate.

Our review of federal policy revealed that policy prioritizes commercial contracting, except in specific circumstances, and prioritizes cost minimization. With that being said, Kessel Run appears to do the exact opposite; the organization has insourced previously outsourced capabilities and prioritized metrics that do not track cost. The benefits of focusing on developing software competency through insourcing has led to better, timely-delivered products. Further research should be done to review other federal government contracting efforts related to outsourcing capabilities to determine if the efforts are in line with federal policy or if they could benefit from deviating from policy as Kessel Run has done.

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